Numerous small forest fires occurred until the 25th when light but general rains cleared the atmosphere. Light frosts were reported in exposed places in extreme eastern Oregon and in southern Idaho on the 26th, 30th, and 31st, for which warnings were, as a rule, issued in time to be of service.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

Disastrous floods occurred during the last decade of August in the rivers of Georgia, North Carolina, and South Carolina, and a flood of moderate proportions prevailed in the James River coincident with the floods in Georgia and the Carolinas. The floods were attributable to heavy and widespread rains over the States drained by these rivers, and more especially to the heavy rains in the southern Appalachian Mountains, where these rivers have their sources. Warnings were issued well in advance of the floods and resulted in the saving of many lives and the protection of much movable property. The following editorial is taken from the Baltimore American of August 28, 1908:

Augusta has been visited by the sweep of the tempest, the storms Wednesday and Thursday making wide wreckage and creating tremendous losses in the southern city. There is naturally a great deal of suffering attending the destruction of property and commodity values, estimated at a million dollars. Hundreds of persons are homeless and many have been thrown out of employment. The Savannah River played havoc with the property lining its banks. Its overflow inundated the city and caused the citizens to take to the boats provided for their rescue.

The value of the Weather Bureau to flood-threatened communities was shown in the warnings issued Tuesday morning that the river, by the following evening, would rise 35 to 37 feet. The citizens, thus forewarned, took to the hills, and many saved their household effects by acting on the prediction. It seems that the flooding of Augusta was aggravated by the system of water supply, consisting of a series of canals and dams in the hills above the city, which thus conveyed the water for the consumption of the people, as well as to supply power for the cotton mills. The overflowing of the central supply caused these canals to become sluices, through which the water poured into the city in great volume.

Throughout Georgia and adjacent States great damage has been done the crops. * * *

Reports in detail concerning these floods follow.

Rivers in other parts of the country were not in flood at any time during the month. As a matter of fact, unusually low stages were prevalent in a number of rivers, the water being so low as to interfere with navigation.

FLOOD IN THE SAVANNAH RIVER.

By D. FISHER, Official in Charge, Local office, Weather Bureau, Augusta, Ga.

The greatest and by far the most destructive flood in the history of this section occurred August 26–27, 1908, which was 0.1 foot higher than the memorable freshet of September 11, 1888.

On the 24th special reports from rainfall and river stations in this district showed the following amounts of rainfall, viz: Anderson, S. C., 5.50 inches; Calhoun Falls, S. C., 4.25 inches; Carlton, Ga., 5.64 inches; Washington, Ga., 0.15 inch, and Greenwood, S. C., 2.46 inches. The river gage at Augusta indicated 11.9 feet.

On the morning of the 25th the river at Augusta had risen to 22.3 feet, and the following rainfall reports were received, viz: Anderson, 5.50 inches; Calhoun Falls, 3.65 inches; Washington, 1.28 inches. Based upon these data, a river forecast was issued announcing a maximum stage of 33 feet in the next twenty-four hours, which was mainly intended for and distributed to the farmers in the lowlands below Augusta, since no damage from this stage would be anticipated at this city. At 10:30 a. m. of the 26th, a forecast was issued stating that the river at Augusta would in all probability reach 36 feet. The following warning was disseminated at 11 a. m.:

Supplemental forecast issued 10:30 a. m., placing the maximum stage at 38 feet by midnight; entire city likely to be submerged by midnight.

At the time of sending the telegram above referred to the water was entering the city, and at noon was rushing thru the streets like a mill race, finally submerging the city, and reaching the highest stage of 38.8 feet about 2 a. m., August 27. The river remained at a stand for about three hours and on the following morning the water had fallen to 33 feet at which stage the flood-stricken people were able to leave their homes. The freshet exceeded the flood of September 11, 1888, by 0.1 foot.

In this connection it is proper to state that all that human effort could do was accomplished by means of the telephone, and, thru advice given, many merchants were able to protect their goods which otherwise would have been ruined. When the water was coming over Broad street, at noon of the 27th, those who were in the stores engaged in saving their property had great difficulty in reaching their homes in safety.

A conservative estimate places the damage as follows, viz:

Money value of property destroyed or damaged, including railroads, etc	$1,000,000
Money value of crops destroyed	50,000
Damage to farm lands by erosion or deposit	10,000
Money value of losses occasioned by enforced suspension of business, including wages of employees, such as causing a shut-down of the four large cotton mills here for a period of at least three months	60,000
Money value of property saved by flood warnings	50,000

FLOODS IN THE OCMULGEE AND OCONEE RIVERS.

By W. A. MITCHELL, Official in Charge, Local Office, Weather Bureau, Macon, Ga.

On the 25th heavy rains occurred over central and northern Georgia. In the basins of the Ocmulgee and Oconee rivers the following rainfalls in inches were reported on the morning of the 25th: Atlanta, 0.76; Griffin, 1.40; Covington, 2.00; Greensboro, 2.36; and Athens, 8.17. The river stage at Macon the morning of the 22th was 11.8 feet and at Milledgeville, 8.9 feet.

The following warning was issued at 8:20 a. m. of the 25th:

Moderate rise expected in the Ocmulgee River to-day, reaching a stage of probably 14.0 feet at Macon. Considerable rise expected in the Oconee, but not to flood stage.

But later in the day a heavy rain of 2.80 inches fell at Macon and vicinity and 1.65 at Athens, and smaller amounts at other points in the upper basin. By 4 p. m. the stage at Macon was 16.7 feet, and at Milledgeville 15.2 feet.

The following warning was then issued:

Continued rains in the basin of the Ocmulgee and Oconee rivers will cause a rise to or near flood stage in both streams.

At 5:30 p. m., the Ocmulgee at Macon had reached 17.5 feet and was still rising. It evidently went near 18 feet during the night, from appearances along the bank the next morning.

The Oconee at Milledgeville at 7 a. m. of the 26th was 24.8 feet, rising. The only rainfall of importance then reported in the Oconee Basin was 1.32 inches at Greensboro. At 3 p. m. the stage at Milledgeville was 29.4 feet, rising, and the following forecast was issued:

Flood crest past Macon last night with a stage of 18 feet; it will reach Abbeville September 1 with a stage of about 14 feet. The Oconee was 29 feet at Milledgeville to-day; this rise will reach Dublin August 30 with stage of about 20 feet.

On the morning of the 27th reports showed a stage of 33.2 feet at Milledgeville and the river was still rising. An advisory warning was accordingly issued to residents in the Oconee Valley to prepare for extreme high water. A report at 3 p. m. showed 32.8 feet and falling. This flood crest reached Dublin on August 30, with a stage of 23.2 feet. The crest of the rise in the Ocmulgee reached Hawkinsville on August 31, with a stage of 12.3 feet; Abbeville on September 2, with a stage of 11.6 feet and Lumber City on September 6, when a height of 9.5 feet was noted.

Some damage resulted from the flood in the upper course of the Oconee, from Milledgeville to Athens. Several bridges and factories were damaged and some cattle lost. In the Omulgee the flood proved to be a blessing to the navigation interests on the river, the boats having been tied up and idle

for some time because of low water. No damage resulted from the rise in this stream.

FLOOD IN THE JAMES RIVER.

By E. A. EVANS, Official in Charge, Local office, Weather Bureau, Richmond, Va.

The rise in the James River, covered by a warning issued on the night of August 23, was preceded by about thirty-six hours of practically uninterrupted rainfall. At intervals the fall was heavy, and generally thruout the watershed the measured amounts reported were abnormal. When the rains set in the river was at stages of zero and below.

By Tuesday night, August 25, the run-off began to show in streams tributary to the James River, and by the morning of the 26th there was a rapid and general rise in that part of the basin east of Lynchburg. At Columbia, Va., the 8 a. m. gage reading was 15.6 feet, and at Richmond 8.8 feet. The subsequent rise at Columbia to the maximum stage of 19.3 feet, was slow, but at Richmond the rate of increase until a stage of 8.2 feet occurred was rapid, averaging 0.7 foot an hour. During the entire day and well into the night the river rose steadily, reaching a maximum stage after midnight of the 26th and then coming to a stand, after which it fell slowly.

The evening of the 25th, warnings of moderate freshet conditions for the lower basin, Scottsville to Richmond, were issued, and telegraphic advices sent to Scottsville and Columbia. Notification was also given by telephone to the Chesapeake and Ohio train despatcher for transmission to other points on the James River division, to the local press and to such of our flood-warning list as could be reached by that means. The warning for Richmond was for a 12-foot rise and was very generally heeded, the steamboat lines removing freight from their lower dock freight sheds, the street car lines preparing for interruption to their service at Lester street, and other interests likely to be affected taking necessary precautions. During the afternoon of the 26th the steamboat docks went under water, and before night street car service was broken at Lester street. This condition lasted thru the night and until the mid-afternoon of the 27th.

The money value of property destroyed or damaged, exclusive of crops, was about $3,000, so far as known, the property being loose timber and false timber work used in repairing the Free Bridge, Richmond to Manchester.

No figures are at hand for an estimate of the value of crops destroyed, or of damage to farm lands, altho the newspapers report it as heavy, or of loss occasioned by enforced suspension of business, if any.

The value of goods placed beyond the reach of damage thru the warnings was about $5,000.

FLOOD IN THE SANTEE RIVER WATERSHED.

By J. W. BAUER, Official in Charge, Local office Weather Bureau, Columbia, S. C.

The following is the report of the Santee River and its confluent tributaries, namely the Congaree, formed by the Broad and Saluda rivers, and the Wateree-Catawba system.

The rainfall that made this possibly the most disastrous flood in the history of South Carolina, began on August 23 and continued in the form of heavy showers, and in places as continuous rain, until the morning of the 26th, having been exceptionally heavy at a number of places, principally in the foothills of the Appalachians, in the form of a belt of country varying from 30 to 80 miles in width, and extending from northern Georgia thru South Carolina, North Carolina, and Virginia.

For the five days ending August 27, the following rainfalls, in inches, were reported: Anderson, S. C., 14.82; Greenville, S. C., 16.94; Catawba, S. C., 10.82; Santuc, 11.33, and Mount Holly, N. C., 11.41. A fall of 9.05 inches in twenty-three hours occurred at Camden, S. C., on the 25–26th.

Excessive rains began at places on the 23d, and were general over the watersheds of the Congaree and Wateree rivers on the 24–25th and at a few places on the 26th. There had been quite heavy rains over the same region from the 19th to the 21st, inclusive, that had nearly saturated the soil, so that the run-off from the following week's rains was more than normal.

The effect can best be shown by the following table of river stages. At some of these stations it was impracticable to secure readings, owing to the fact that the river gages were lost, and there was no exact method or even approximate marks by which to estimate the height of the water.

TABLE 1.—*River stages in South Carolina during August, 1908, in feet.*

Date.	Pelzer, S. C.	Chappells, S. C.	Blairs, S. C.	Columbia, S. C.	Mt. Holly, N. C.	Catawba, S. C.	Camden, S. C.	Rimini, S. C.	Ferguson, S. C.
August 23	4.2	2.9	1.8	1.4	4.6	8.3	16.1	10.7	11.5
August 24	5.4	12.9	10.8	8.3	4.8	10.2	19.4	11.5	11.5
August 25	25.6	16.8	22.0	21.2	10.0	28.4	29.0	12.4	11.7
August 26	14.0	34.7	31.1	26.6	14.2	28.0	39.7	12.9	12.2
August 27	9.8	.....	31.0	35.8	12.0	28.0	38 4	13.3	12.4
August 28	5.8	.....	23.0	34.7	5.0	20.0	35.2	22.4	13.0
August 29	5.6	.....	10.0	22.7	3.0	12.0	32.6	31.7	14.7
August 30	5.1	.....	4.2	14.5	2.8	5.0	21.0	33.8	21.5
August 31	4.7	.....	2.2	7.3	2.8	4.5	16.5	32.0	23.7

Advisory and cautionary warnings were issued on the night of the 23d, and the next morning warnings were issued for the Wateree River with the information that the river would rise above flood stage in the next twenty-four hours. On the morning of the 25th all interested persons in the Congaree, Wateree, and Santee valleys were warned to get all movable property on high ground as an unusual flood was imminent. Warnings were issued for a stage of 28 feet at Columbia and 32 feet at Camden, and later in the afternoon a statement was given to the paper stating that the present flood would probably exceed those stages.

No movable property would have been lost if the owners had heeded the advice of this office to remove live stock to high ground, but, relying on the previous high-water marks and not believing that these would be exceeded, a number of cattle and horses were lost. The inhabitants or planters of the Santee River Valley were warned in ample time and the loss of live stock was avoided.

Losses by flood in South Carolina.

Value of property destroyed, excluding crops	$571,800
Value of crops destroyed	312,200
Damage to farm land by erosion or deposit	177,800
Suspension of business of employees	82,000
Total loss	$1,143,800

Money value of property saved by warnings of the Weather Bureau, $56,000.

Heavy rains almost without interruption from August 14 to 27, caused floods in eastern North Carolina.

The Roanoke River began to rise on the 23d. From the 24th to the 27th it rose approximately 10 feet a day to a maximum stage of 45.7 feet during the night of the 27th–28th. The floods in the Roanoke were not so disastrous as those in other portions of the State, but there was, however, an immense loss of property.

The Tar River rose slowly to a maximum stage of 19.4 feet on September 2, but did not reach the flood stage.

The worst floods occurred in the valley of the Cape Fear River. This river reached a maximum stage of 67.5 feet at Fayetteville, N. C., on August 29, which was higher than ever before recorded. Warnings were issued in advance of this flood to the effect that the river would reach a stage of 66 feet. The damage by floods along the river was very large, many county bridges being washt away and some railroad bridges threatened. The river flooded all the lowlands, a portion of the city of Fayetteville, and caused much suffering and material loss.

The highest and lowest water, mean stage, and monthly range at 212 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*E. H. Bowie, Local Forecaster.*

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

ANNUAL RISE OF THE COLUMBIA RIVER IN 1908.[1]

By E. A. BEALS, District Forecaster. Dated Portland, Oreg., August 26, 1908.

As is well known the annual rise of the Columbia River is almost wholly due to the melting of the winter's snow in the mountains and foot hills within the Columbia River drainage basin.

The following table shows the highest water and the date of its occurrence this year at all stations on the Columbia River and its principal tributaries:

TABLE 1.—*Flood crests, Columbia watershed, 1908.*

Stations.	Height.	Date.
	Feet.	
Bonners Ferry	27.8	June 10 and 11.
Newport	21.7	June 16, 17, 18, and 19.
Lewiston	14.1	June 15 and 16.
Wenatchee	41.0	June 18.
Umatilla	21.9	June 17 and 18.
Celilo	19.1	June 18.
The Dalles	37.1	June 18.
Cascade Locks	29.6	June 19.
Vancouver	22.4	June 21.
Riparia	13.7	June 17.
Portland	21.2	June 20 and 21.

The accompanying hydrograph, fig. 1, shows the behavior of the river at Wenatchee, Wash., 200 miles above the junction of the Columbia and the Snake rivers; at Lewiston, Idaho, on the Snake River, 200 miles from its mouth; and at Vancouver, Wash., about 100 miles from the mouth of the Columbia.

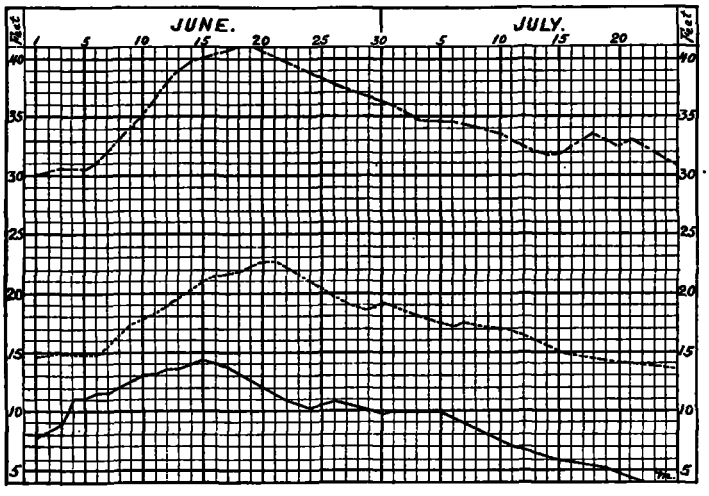

FIG 1.—Hydrographs of daily stages on the Columbia and Snake rivers.
-·-·-·- Columbia River, at Wenatchee, Wash.
------- Columbia River, at Vancouver, Wash.
——— Snake River, at Lewiston, Idaho.

As compared with last year, the rise this year was about two feet higher in the lower stretch of the river where the width was normal. The rise also occurred about twelve days later than last year. It overflowed the bottom lands to a depth of about five feet for 20 miles on either side of Vancouver. All the lower docks of the city of Portland were flooded, as well as the cellars along the water front. Forecasts of this flood were begun on May 20 and continued until July 12. They were very accurate, and the high water did no damage except such as resulted from the flooding of a small amount of cultivated ground.

For comparative purposes the best record of the temperature and precipitation over the drainage basin of the upper Columbia and the Snake rivers is that given monthly by Table I of the MONTHLY WEATHER REVIEW, under the subheading Northern Plateau. The average precipitation and mean temperatures together with the departures from normal in that district for November and December, 1907, and for January, February, and March, 1908, are given in Table 2.

TABLE 2.—*Temperature and precipitation of northern Plateau during cold season 1907–8.*

Year and month.	Temperature.		Precipitation.	
	Mean.	Departure.	Average.	Departure.
1907.	°F.	°F.	*Inches.*	*Inches.*
November	41.6	+2.9	0.89	−0.5
December	34.8	+2.7	2.12	+0.4
1908.				
January	32.7	+3.9	0.76	−0.9
February	35.2	+3.1	1.13	−0.4
March	41.7	+1.5	0.95	−0.6
	37.2	+2.8	5.85	−2.0

This table shows that the precipitation was about 2 inches short of the normal, but during November and December, 1907, the amount was nearly normal. The snow that fell during this time packed solidly, and at the end of March the special reports regarding the winter's snowfall showed that about the normal amount had fallen in British Columbia, northern Idaho, and western Montana, while in southern Idaho and northern Wyoming there was a slight deficiency. The temperature during the entire snow season was uniformly above normal. Taking these conditions alone into consideration, a moderate rise only could be expected, which would occur a little later than usual on account of the snow being so solidly packed.

The determining factor in this flood crest which recurs each year is not so much the amount of snow that falls as the way it melts in the spring. If the mean temperature during April is above normal, and this month is followed by a mild May, the rise unusually comes earlier, and is not apt to bring very high water. If, however, the spring is backward, and a long hot spell occurs in May, then the snow melts rapidly and high water follows. This year we had a warm April in the mountains with the temperature about 2° above normal, but May was cold and very little snow melted during that month. Consequently, when the warm weather of June came the snow melted quickly resulting in a flood crest about 2 feet higher, and nearly two weeks later than last year.

TABLE 3.—*Flood crest at Portland, Oreg., during the annual rise of Columbia River.*

Year.	Stage.	Year.	Stage.	Year.	Stage.	Year.	Stage.
	Feet.		*Feet.*		*Feet.*		*Feet.*
1879	19.3	1887	25.7	1895	16.3	1903	24.0
1880	27.3	1888	18.2	1896	23.8	1904	20.8
1881	19.7	1889	10.0	1897	23.7	1905	13.6
1882	26.1	1890	20.1	1898	20.7	1906	13.4
1883	17.8	1891	14.1	1899	24.2	1907	19.2
1884	20.2	1892	19.3	1900	17.8	1908	21.2
1885	14.5	1893	22.0	1901	20.8		
1886	20.0	1894	38.0	1902	20.7		

[1] This report was received too late for insertion in the July Monthly Weather Review.